

WHAT IS CLAIMED IS:

1 1. A fault detection method comprising:
2 sensing a group of correlating operational parameters of a
3 semiconductor processing tool operating under a recipe;
4 sensing at least one non-correlating operational parameter of the tool
5 operating under the recipe;
6 forming an input vector including the group of correlating operational
7 parameters and the at least one non-correlating operational parameter;
8 comparing the input vector to a reference data library comprising vectors
9 from previous tool runs utilizing the recipe;
10 selecting from the reference data library one or more nearest neighbor
11 vectors to the input vector based upon a similarity with the group of correlating
12 operational parameters; and
13 generating a fault detection index from the selected nearest neighbor
14 vectors.

1 2. The method of claim 1 wherein sensing the group of correlating
2 operational parameters comprises sensing operational parameters relating to tool
3 pressure.

1 3. The method of claim 1 wherein sensing the group of correlating
2 operational parameters comprises sensing operational parameters relating to tool
3 temperature.

1 4. The method of claim 1 wherein sensing the group of correlating
2 operational parameters comprises sensing operational parameters relating to tool power.

1 5. The method of claim 1 wherein sensing the group of correlating
2 operational parameters comprises sensing operational parameters relating to positioning
3 of a wafer within the tool.

1 6. The method of claim 1 wherein the fault detection index is
2 generated by compiling a vector subset from the selected nearest neighbor vectors,
3 combining the vector subset into an output prediction vector, and generating a fault
4 detection index from the output prediction vector.

1 7. The method of claim 6 wherein the output vector comprises
2 predicted operational parameters, and the fault detection index is generated by
3 combining the predicted operational parameters.

1 8. The method of claim 7 wherein combining the operational
2 parameters of the output prediction vector comprises:
3 assigning a set of weights to the predicted operational parameters; and
4 adding together the weighted operational parameters.

1 9. The method of claim 8 wherein the set of weights is assigned
2 based upon the similarity.

1 10. The method of claim 1 further comprising:
2 including in the input vector a value of a passive-inclusive sensor,
3 ignoring the value of the passive-inclusive sensor in selecting the nearest
4 neighbor vectors; and
5 including the value of the passive-inclusive sensor in generating the fault
6 detection index.

1 11. The method of claim 1 further comprising:
2 including in the input vector a value of a cluster sensor;
3 including the value of the cluster sensor in selecting the nearest neighbor
4 vectors; and
5 ignoring the cluster sensor in generating the fault detection index.

1 12. The method of claim 11 wherein the cluster sensor represents a
2 stage in a semiconductor fabrication process when the group of correlating operational
3 parameters is sensed.

1 13. The method of claim 6 wherein the vectors of the reference data
2 library include a synthetic sensor, the method further comprising:
3 including in the input vector a null value of the synthetic sensor; and
4 obtaining a predicted value of the synthetic sensor from the output
5 prediction vector, the synthetic sensor ignored in selecting the nearest neighbor vectors
6 and ignored in generating the fault detection index.

1 14. The method of claim 13 wherein the synthetic sensor is difficult
2 or impossible to measure in real time during operation of the semiconductor fabrication
3 tool, and is assigned to vectors of the library after completion of the processing.

1 15. An apparatus for detecting a fault in a semiconductor processing
2 tool, the apparatus comprising:

3 a first sensor, a second sensor, and a third sensor operatively coupled to
4 the semiconductor processing tool;

5 a controller in communication with the semiconductor processing tool
6 and with the first, second, and third sensors;

7 a memory coupled to the controller, the memory storing a computer
8 program in computer readable format including computer instructions to control said
9 controller to,

10 receive from the first and second sensors correlating operational
11 parameters of the semiconductor processing tool operating under a recipe,
12 receive from the third sensor a non-correlating operational parameter
13 from the tool;

14 compare the correlating operational parameters to corresponding
15 operational parameters recorded during prior runs of the tool utilizing the
16 recipe, and

17 generate a fault detection index from comparing the sensed correlating
18 operational parameters to the corresponding operational parameters recorded
19 during prior runs.

1 16. The apparatus of claim 15 wherein the correlating operational
2 parameters relate to tool pressure.

1 17. The apparatus of claim 15 wherein the correlating operational
2 parameters relate to tool temperature.

1 18. The apparatus of claim 15 wherein the correlating operational
2 parameters relate to tool power.

1 19. The apparatus of claim 15 wherein the correlating operational
2 parameters relate to positioning of a wafer within the tool.